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TAMPER DETECTION FOR BODY WORN TRANSMITTER

BACKGROUND OF THE INVENTION

61123 U.S. PRO
08/863158
05/27/97

5 1. Field of the Invention

10 This invention relates to body worn transmitters and methods for determining if tampering has occurred. More particularly, it refers to methods of detecting removal of a transmitter without inhibiting the subject's ability to perform his or her occupation.

2. Description of Prior Art

15 Body worn transmitters containing tamper detection elements are used today with a fixed position monitoring receiver for the purpose of house arrest, curfew sentencing, pre-trial sentencing, parole and probation. Today, tamper detection only can be reported while the body worn transmitter is communicating with an associated monitoring receiver in a fixed location. Recently, portable monitoring receivers for body worn transmitters
20 determining location using radio triangulation have been designed to report the location of tampering with a body worn transmitter whenever and wherever such tampering occurs. The current house arrest tamper detection systems however, do not allow subjects to have occupations requiring them to be immersed in water above the body worn transmitter. Such immersion in water prevents
25 operation of the transmitter to the associated monitoring receiver. Either being immersed in an electrolyte solution or not being able to communicate with the monitoring receiver due to immersion results in potentially false tampering reports.

the effects of removing the transmitter since the electrolytic nature of the saline solution exhibits the same capacitance as the human body. While immersed, the transmitter cannot radiate to the associated monitoring receiver because the transmitted signal is attenuated with the antenna immersed. For this reason, immersion in an electrolytic solution, such as a chlorine solution or brackish water will register as a tampering signal for the transmitter as described in U.S. Pat. No. 5,298,884.

A transmitted signal from the current body worn transmitters is capable of being recorded using a scanner and retransmitted using a signal generator in order to mislead the monitoring receiver. Such action would allow transmitter tampering to occur without detection by the monitoring receiver. Body worn transmitters need to latch when tampering is detected. If a notification of tampering is determined to be false, then a system to reset the tamper latch remotely is desired to remove the need to physically reset the tamper latch on the body transmitter.

There exists a need to improve detection of tampering with body worn transmitters. In addition, subjects wearing transmitters having occupations requiring physical activity generating sweat or immersed in electrolyte solutions above the body worn transmitter need to be protected from the generation of false tampering signals. In the case of a confirmed false tampering signal, there is a need for a system to reset the tamper latch as set forth above.

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The integrity of the signal between the body worn transmitter and the monitoring receiver also needs to be improved to prevent misleading tamper detection signals generated by the body worn transmitter or masking of the tamper detection signal by the subject.

SUMMARY OF THE INVENTION

The tamper detection deficiencies of the prior art system is solved by the twenty-four hour monitoring system of this invention. A portable monitoring receiver is required to be carried by the subject wherever he or she moves in the community. An antenna is imbedded in a strap attached to the body worn transmitter continuously communicating with the portable monitoring receiver. A strap alarm electrically couples the antenna to the transmitter. The transmitter contains a program exhibiting a unique identification coded signal, data encryption for the coded signal, tamper detection using an antenna reflected power sensor and level detector, an antenna voltage standing wave ratio sensor and change detector and a transmitter cover pressure sensitive switch. In addition, there is an electrolyte immersion sensor sending a tamper inhibit signal via the antenna. A real-time clock in the body worn transmitter prevents masking the detection of tampering and provides a remote method of resetting the tamper latch.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention can be best understood by those having ordinary skill in the art by reference to the following detailed

description when considered in conjunction with the accompanying drawings in which:

FIG. 1 is a diagram of a prior art house arrest system including a body worn transmitter, a fixed location monitoring receiver at the offender's residence and monitoring center;

FIG. 2 is a diagram of a twenty-four hour portable locating system employed in this invention showing body worn transmitter, portable monitoring receiver and central data base;

FIG. 3 is an exploded view of the body worn transmitter describing the strap antenna and body worn transmitter case;

FIG. 4 is a schematic of the body worn bracelet circuitry;

FIG. 5 is a block diagram describing the body worn transmitter incorporating data encryption to prevent tamper by spoofing, the strap antenna and a reflected power and VSWR tamper detection apparatus; and

FIGS 6A-6H are Smith Chart polar diagrams containing constant-resistance circles used to calculate data for Examples 1-8, respectively, in the specification.

DETAILED DESCRIPTION

Throughout the following detailed description, the same reference numerals refer to the same elements in all figures.

FIG. 1 illustrates the prior art house arrest system for a subject incorporating a body worn transmitter that communicates with a monitoring receiver at the subject's

residence 14 to determine when the subject is at the residence 14. When the subject 12 leaves the residence 14, the monitoring receiver 13 can no longer receive signals from the body worn transmitter 11 on the subject 12. The monitoring receiver 13, using house power 16 or internal batteries, generates a phone call via the house telephone line 18 through the public switched telephone network 19 to the monitoring center 22 where the host computer 24 compares the allowable departure times to the time of the call from the monitoring receiver 13 at the subject's residence 14.

Tamper detection in the prior art house arrest body worn transmitter 11 can only report tampering signals to the subject 12 and the monitoring center 22 while the transmitter 11 is within range of the fixed location monitoring receiver 13. Therefore, while the subject 12 is away from his or her residence 14, activities are not reported that would trigger tampering signals or a violation of the subject's schedule or location. This prior art system is subject to recording and retransmission known in the art as spoofing. This can either mask tampering with the transmission signal from the body worn transmitter 11 or make the transmitter 11 appear within range of the monitoring receiver when it is actually out of range.

FIG. 2 illustrates the twenty-four hour portable locating system 30 of this invention. The subject 12 has an improved body worn transmitter 34 communicating with a portable monitoring receiver 36 carried by the subject 12 from his or her residence

14 to allowed locations such as his her workplace. Since there is no hard line phone number to verify the location of the monitoring receiver 36, radio signal triangulation from satellites 48 is performed in the portable monitoring receiver 36 allowing the monitoring receiver to determine its location. Location information for the subject 12 as well as transmitter 34 and portable monitoring receiver 36 health and status information is reported using a wireless network 38 and the public switched telephone network 19 to a central monitoring facility 42 where a subject's movements can be recorded for real-time or historical processing. When the subject is at his or her residence 14, the twenty-four hour portable monitoring receiver 36 connects directly to the public switched telephone network 19 using the subject's residential telephone line 18 connected to the battery charging stand 40.

Community supervision sentencing guidelines for the subject are provided by the supervising criminal justice agency 44 which can review the subject's current or recorded location data for any violations. Law enforcement 46 also can review the subject's current or recorded location data and can be dispatched to the subject's current location for apprehension of the subject.

Key requirements for the proper operation of the portable system of this invention are that 1) tamper detection for the body worn transmitter 34 must be performed at all times in order to verify the integrity of the body worn transmitter 34 and 2) the radio signals between the body worn transmitter 34 and the

monitoring receiver 36 must not be altered or mimicked to spoof the monitoring receiver 36. These requirements are essential in order to verify the subject's location while he or she move about the community.

5 FIG. 3 illustrates the twenty-four hour portable system body worn transmitter 34. The attaching strap 52 is cut to fit the subject's ankle and is locked to the transmitter housing 54 by strap clamps 56 at each end of the attaching strap 52. The inner core 58 of the attaching strap 52 is a corrosion resistant metal foil coated with a soft synthetic insulating material 60. The strap clamps 56 secure the body worn transmitter 34 to the subject's body. In addition the strap clamps 56 electrically connect the attachment strap inner core 58 which acts as an antenna to the transmitter electronic circuit board 62 using embedded wires in the transmitter case between the tapped threads 65 for the strap clamp screws 63 and the transmitter electronics circuit board 62. The attachment strap antenna 58 inductively couples the transmitted signal energy to the body of the subject. This method uses the body of the subject as the antenna for the body worn transmitter. The body worn transmitter circuit board 62 is powered by a replaceable battery 64. The body worn transmitter housing 54 has a pressure sensitive switch 66 to determine when the cover 68 is removed. A waterproof gasket 61 seals the cover 68 to the housing 54 of the body worn transmitter protecting the transmitter electronics. The cover 68, when attached, covers the access to the strap clamp screws 63 forming

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tamper detection for access to strap clamps 56. Since the strap clamps 56 electrically connect the antenna 58 to the transmitter circuit board 62, removal of the strap clamps 56 will generate a tampering signal when the transmitter circuit board 62 loses connection to the antenna 58.

When the body worn transmitter circuit board 62 is transmitting and the subject's body is functioning as an inductively coupled antenna through the inner core 58 of the attachment strap 52, radio power from the transmitter 34 is radiated by the antenna formed by the subject's body. The body of the subject becomes an antenna by the loop formed by the attachment strap antenna 58. This loop serves as a winding of a coil inducing transmitter power on the body of the subject. If the body worn transmitter 34 is removed from the body, the radio power from the transmitter 34 cannot be inductively transferred to the subject's body through the attaching strap antenna and is reflected back to the transmitter 34. The body worn bracelet circuitry shown in FIG. 4 detects changes to the antenna reflected radio power or the voltage standing wave ratio (VSWR).

By utilizing the human body as a radiator of radio energy with very low power, FCC approved transmitters operating below 500 MHz, any portion of the body not immersed in an electrolyte serves as an antenna for the body worn transmitter. This permits the body worn transmitter to remain in contact with the monitoring receiver. By embedding the transmitter antenna 58 in the attaching strap 52, the antenna must be altered in order to

remove the body worn transmitter. Further, by measuring the reflected energy of the antenna coupling to the human body, any changes to the radio frequency characteristics of the antenna can be detected. Using a jumper wire to bridge a cut to the strap antenna or removing the transmitter from the body changes the antenna characteristics which will change the reflected energy of the antenna. Detecting changes to the reflected energy against a set threshold or changes to the ratio of transmitter power to the antenna reflected power will indicate tampering with the attachment strap. The ratio of transmitter power to reflected power is commonly called reflection coefficient ($10 \cdot \log (\text{power reflected} / \text{power coupled})$).

The FIG. 4 schematic illustrates the improved body worn transmitter tamper detection circuit for the portable locating system. A directional coupler 70 is used to detect the reflected antenna 58 power or the ratio of power from the transmitter 34 to the reflected power from the antenna 58. In order for the ratio to be constant, the load impedance of the antenna 58 must remain constant. The portion of the power reflected from the antenna divided by the power sent from the antenna is known as the reflection coefficient.

The directional coupler 70 reflected port 92 is connected to a reflected power detector 76 that detects when the antennae reflected power is greater than a preset threshold 78 value. The directional coupler 70 reflected port 92 and the transmitter coupled port 90 are connected to an analog comparator 94 that

detects changes in the reflection coefficient.

The reflected power 76 and VSWR detection circuit sensor 94 is based on a parallel transmission line directional coupler 70 consisting of three equal lengths of wire twisted together. The first transmission line 80 connects the transmitter 34 to the antenna 58. This transmission line will carry the voltage and current between the transmitter 34 and the antenna 58. This transmission line will have both the forward component from the transmitter 34 to the antenna 58 and the reflected component from the antenna 58 to the transmitter 34. The forward component of voltage and current are always in phase with each other, but the reflected components are always 180 degrees out of phase with each other. The second transmission line 82 is terminated at both ends to the radio frequency ground 84. The third transmission line 86 is terminated at both ends to radio frequency ground 84 through a resistor 88 at each end of the transmission line 86.

On the transmitter end of transmission line 86, a measure of transmitter coupling is possible before the voltage drop 90 across the resistor 88 to radio frequency ground 84. On the antenna end of transmission line 86, a measure of antenna reflected power is possible before the voltage drop 92 across the resistor 88 to radio frequency ground. A fraction of the forward and reflected voltage on the first transmission line 80 is coupled by capacitance to the third transmission line 86. A fraction of the forward and reflected current in the first

transmission line 80 is coupled by inductance to the third transmission line 86 and develops a voltage across the terminating resistors 88.

The forward power can be measured at the couple port 90 resistor because the forward voltage and current are in phase with each other but the reflected voltage and current are 180 degrees out of phase and cancel.

The reflected power can be measured at the reflected port 92 resistor because the reflected voltage and current are in phase with each other but the forward voltage and current are 180 degrees out of phase and cancel.

Along the first transmission line 80 there will be locations where the forward and reflected voltage will be additive in phase and other locations where the forward and reflected voltage will be subtractive in phase. VSWR is the ratio of the peak additive voltage to the minimum subtractive voltage measured across the coupled port 90 and the reflected port 92.

FIG. 5 illustrates the functional block diagram of the tamper detection for body worn transmitters of this invention. The reflected power detector 100 is an analog comparator that measures the reflected energy 102 sensed by the directional coupler 105 and compares it against a reference threshold 106 set at the desired reflected energy level when the antenna 58 is coupled to the body of the subject 12. The reflected power detector 100 can also be a VSWR detector by replacing the threshold voltage 106 with the voltage measured at the coupled

port 104 of the directional coupler 105.

The electrolyte immersion detector 110 senses when the body worn transmitter housing 54, cover 68 and attachment strap antenna 58 (FIG. 3) are immersed in an electrolyte solution using an open continuity circuit completed by the electrolyte. A pin end 69 of the open continuity circuit is located on the case facing the body making it inaccessible to the wearer of the body worn transmitter 34. Since immersion of the attachment strap antenna 58 in an electrolyte will change the impedance of the attachment strap antenna 58 and its reflected energy, the immersion detector is needed to send an inhibit signal 115 to the strap tamper detection logic 120 to prevent a false tamper detection. The strap tamper detection logic 120 will not send the reset real time clock signal 147 to the real time clock 145. If the subject 12 cuts the attachment strap antenna 58 while immersed and removes the body worn transmitter, the body worn transmitter signal will no longer be received by the portable tracking device since the subject's body no longer performs as the antenna exposed above the electrolyte solution. The portable monitoring receiver 36 will report the lack of signal as a violation.

The body worn transmitter 34 sends strap tamper detection signal 125 as part of coded information 127 which is modulated on the transmitter's signal. In addition the strap tamper detection logic 120 will send a signal to reset the real time clock 145. The transmitter circuitry matches the attachment strap antenna 58

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to an approximate 50 ohm impedance using an adjustment 134. The body worn transmitter strap tampering signal cannot be defeated by jumpering a cut attachment strap antenna 58 since the jumper will change the impedance of the antenna thereby changing the reflected energy. The strap tamper detection logic 120 cannot be bypassed inside the body worn transmitter housing 54 since the body worn transmitter 34 has case tamper detection 132 for an attempt to open the housing 54. The case tamper detection logic 132 also will send a reset signal 147 to the real time clock 145.

Other tamper defeating features of the body worn transmitter are an unique identification code 135 for each body worn transmitter, battery level reporting 140, a real-time clock 145 and data encryption 150.

The unique identification code 135 prevents mixing tamper detection reporting from multiple body worn transmitters in the reception area of the associated portable monitoring receiver. Body worn transmitter battery level reporting 140 prevents false tamper detection when the portable monitoring receiver can no longer receive the body worn transmitter signals due to a low battery condition.

The real-time clock 145 provides a public encryption key for data encryption 150. Data encryption 150 prevents the duplication of the body worn transmitter signals for the purpose of masking tamper detection codes. The real-time clock 145 allows any portable monitoring receiver to decrypt the encrypted data 150 transmitted by the body worn transmitter by using the

directional coupler 70. Each Example contains data from a Smith Chart with measured data points for multiple body worn transmitter frequencies.

EXAMPLE 1

l: Mkr	Frequency (MHz)	Table of Measurements	
		Ohm	Ohm
1:	406.00	66.11	-363.9
2:	410.00	55.28	-328.5
3:	414.00	50.19	-308.2
4:	418.00	49.96	-280.8
5:	422.00	47.6	-268.8
6:	426.00	41.5	-252
7:	430.00	40.95	-237.1
8:	434.00	42.97	-226.5

In the data of Example 1 taken from the Smith Chart 200 in FIG. 6A, the horizontal axis 205 of the Smith Chart 200 represents normalized or constant resistance. In the measurements for the attachment strap antenna 52, the normal impedance is at 50 ohms when inductively coupled to the body of the subject. The left half of the Smith Chart is high impedance and the right side is low impedance. The top half of the Smith Chart is positive reactance and inductive. The bottom of the Smith Chart is negative reactance and capacitive.

FIG. 6A measurements were obtained from a connected (i.e., at both ends) 10 inch circumference attachment strap antenna 52 but not placed on the body of a subject. The data points 202 from the table of measurements at the indicated range of frequencies depict negative reactance, very high resistance and high impedance with the attachment strap antenna coupled to air.

EXAMPLE 2

		Table of Measurements	
	Frequency		
1:	Mkr	(MHz)	Ohm
1:		406.00	60.07
2:		410.00	61.64
3:		414.00	62.48
4:		418.00	63.13
5:		422.00	62.07
6:		426.00	61.28
7:		430.00	59.29
8:		434.00	59.35

FIG. 6B measurements were obtained from a connected 10 inch circumference attachment strap antenna 52 placed loosely on the body of the subject. The data points 210 from the table of measurements depict a measurable reduction in resistance and a measurable increase in inductance. These observations demonstrate the capability for the body worn transmitter 34 to measure the VSWR difference between a functioning attachment strap antenna 52 coupled loosely to the body of a subject versus not being coupled to the body of a subject.

EXAMPLE 3

		Table of Measurements	
	Frequency		
1:	Mkr	(MHz)	Ohm
1:		406.00	51.68
2:		410.00	52.56
3:		414.00	53.64
4:		418.00	54.68
5:		422.00	55.78
6:		426.00	56.97
7:		430.00	58.19
8:		434.00	59.39

FIG. 6C measurements were obtained from a connected 10 inch circumference attachment strap antenna 52 placed closely to the body of the subject. The data points 220 from the table of measurements depict a measurable reduction in resistance, an

increase in inductance and a transition to neutral reactance. These observations form a measurable trend from no coupling to loose coupling to close coupling to the subject's body.

EXAMPLE 4

1:	Mkr	Frequency	Table of Measurements	
		MHz	Ohm	Ohm
1:		406.00	32.23	-56.36
2:		410.00	32.72	-55.11
3:		414.00	31.92	-53.84
4:		418.00	31.76	-52.81
5		422.00	31.34	-51.49
6:		426.00	31	-50.27
7:		430.00	30.72	-48.59
8:		434.00	30.91	-48.08

FIG. 6D measurements were obtained from a fourteen inch circumference strap antenna 52 simulating an ideal severed attachment strap antenna 52 with a conductive jumper placed loosely on the subject's body. The data points 230 from the table of measurements depict a measurable difference in reactance, inductance and resistance to the data in FIG. 6B where the attachment strap antenna was placed loosely on the subject's body. These observations demonstrate the capability to detect the attachment strap antenna being jumpered and severed while still being loosely coupled to the subject's body.

EXAMPLE 5

1.	Mkr	Frequency	Table of Measurements	
		MHz	Ohm	Ohm
1:		406.00	40.88	-205.2
2:		410.00	36.11	-197.3
3:		414.00	33.96	-190.4
4:		418.00	32.65	-186.4
5:		422.00	27.95	-176.2
6:		426.00	25.28	-171.9
7:		430.00	26.13	-164.8
8:		434.00	24.78	-160.2

FIG. 6E measurements were obtained from a connected 14 inch circumference attachment strap antenna but not placed on the body of the subject. The data points 240 from the table of measurements depict that the reflected power characteristics (i.e., reactance and inductance) of a 14 inch and a 10 inch circumference antenna are similar, thereby making the measurements independent of the length of the attachment strap antenna.

EXAMPLE 6

		Table of Measurements		
1.	Mkr	Frequency MHz	Ohm	Ohm
1:		406.00	7.682	12.86
2:		410.00	7.508	12.55
3:		414.00	7.66	12.88
4:		418.00	7.847	12.9
5:		422.00	8.035	13.3
6:		426.00	8.045	12.8
7:		430.00	8.249	13.49
8:		434.00	8.384	13.19

FIG. 6F measurements were obtained from a connected 10 inch circumference attachment strap antenna immersed in salt water (strong electrolytic solution) but not placed on the body of the subject. The data points 250 from the table of measurements depict a measurable transition from negative to positive reactance and a lower impedance value than all other tests with the attachment strap antenna not immersed in an electrolyte. These observations demonstrate the capability to detect when the attachment strap antenna is immersed in a strong electrolyte solution.

EXAMPLE 7

1.	Mkr	Frequency	Table of Measurements	
		MHz	Ohm	Ohm
1:		406.00	2.553	9.756
2:		410.00	2.615	9.52
3:		414.00	2.679	10.49
4:		418.00	2.628	10.08
5:		422.00	2.82	11
6:		426.00	2.73	11.31
7:		430.00	2.901	11.97
8:		434.00	3.246	12.25

FIG. 6G measurements were obtained from a connected 10 inch circumference attachment strap antenna immersed in tap water (weak electrolytic solution) but not placed on the body of the subject. The data points 260 from the table of measurements establishes that immersion of the attachment strap antenna in a weak electrolytic solution has similar results to immersion in a strong electrolytic solution from FIG. 6F.

EXAMPLE 8

1.	Mkr	Frequency	Table of Measurements	
		MHz	Ohm	Ohm
1:		406.00	4.135	8.922
2:		410.00	4.349	8.947
3:		414.00	4.325	9.607
4:		418.00	4.489	9.416
5:		422.00	4.599	10.02
6:		426.00	4.568	9.861
7:		430.00	4.455	10.6
8:		434.00	4.388	10.55

FIG. 6H measurements were obtained from a connected 10 inch circumference attachment strap antenna immersed in tap water (weak electrolytic solution) coupled closely to the body of the subject. The data points 270 from the table of measurements depict that the immersion of the attachment strap antenna has similar results to immersion with the attachment strap antenna

CLAIMS

1. A tamper detection system for a body worn transmitter attached to a subject's body comprising:

a portable monitoring receiver in proximity to the body worn transmitter continuously receiving signals from the body worn transmitter and a global positioning satellite;

the body worn transmitter having an antenna imbedded in a strap for communicating with the portable monitoring receiver, the antenna inductively coupled to the body of the subject and means for electrically coupling the antenna to the transmitter;

the body worn transmitter having programmed therein a coded identification signal, a data encryption for the coded identification signal, a real time clock and means to detect tampering with the body worn transmitter; and

the body worn transmitter additionally containing an electrolyte immersion sensor sending a tamper inhibit signal via the antenna to the portable monitoring receiver and then to a base station.

2. The tamper detection system according to claim 1 wherein the body worn transmitter emits a battery level signal.

3. A tamper detection system according to claim 1 wherein the body worn transmitter emits a real time clock data signal.

4. A tamper detection system according to claim 1 wherein the antenna has a conductive corrosion resistant metal foil core and a resistive coating to prevent direct electrical contact with the

subject's body.

5. A tamper detection system according to claim 1 wherein the means for electrically coupling the antenna to the transmitter is a strap clamp.

6. A tamper detection system according to claim 1 wherein the means to detect tampering with the transmitter are an antenna reflected power sensor and level detector, an antenna voltage standing wave ratio sensor and change detector and a transmitter cover pressure sensitive switch.

7. A tamper detection system according to claim 6 wherein the detection of a tamper is noted by the base station and the body worn transmitter is reset by a signal from the base station.

8. A tamper detection system according to claim 1 having a data encryption system located between the body worn transmitter and the portable monitoring receiver, the encryption system using the real-time clock as a public data encryption key.

9. A tamper detection device in a body worn transmitter attached to a subject's body and adapted to continuously send electrical signals to a nearby portable monitoring receiver, the body worn transmitter comprising:

an antenna imbedded in a strap for communicating with the portable monitoring receiver, the antenna inductively coupled to the body of the subject and a means for electrically coupling the antenna to the transmitter;

the body worn transmitter having programmed therein a coded identification signal, a data encryption for the coded

identification signal, a real time clock and means to detect tampering with the body worn transmitter; and

the body worn transmitter additionally containing an electrolyte immersion sensor which sends a tamper inhibit signal to a tamper detection circuit in the body worn transmitter.

10. The tamper detection device in a body worn transmitter according to claim 9 wherein the body worn transmitter antenna has a conductive corrosion resistant metal foil core and a resistive coating to prevent direct electrical contact with the subject's body.

11. The tamper detection device in a body worn transmitter according to claim 9 wherein the means for electrically coupling the antenna to the transmitter is a strap clamp.

12. The tamper detection device in a body worn transmitter according to claim 9 wherein the means to detect tampering with the transmitter are an antenna reflected power sensor and level detector, an antenna voltage standing wave ratio sensor and charge detector and a transmitter cover pressure sensitive switch.

13. The tamper detection device on a body worn transmitter according to claim 9 wherein the body worn transmitter has a housing with a base proximal to the subject, the base containing a false strap tamper detection sensor.

14. A tamper detection device in a body worn transmitter according to claim 9 wherein the real time clock provides a

remote means to reset the tamper detection latch.

15. A tamper detection system for a body worn transmitter strapped to a subject's body appendage comprising:

a portable monitoring receiver in proximity to the body worn transmitter continuously receiving signals from the body worn transmitter and a global positioning satellite; and

the body worn transmitter having an antenna imbedded in a strap for communicating with the portable monitoring receiver, the antenna inductively coupled to the body of the subject and a strap clamp electrically coupling the antenna to the transmitter;

the body worn transmitter having programmed therein a coded identification signal, a data encryption for the coded identification signal, a real time clock emitting a real-time clock data signal and an antenna reflected power sensor and level detector, an antenna voltage standing wave ratio sensor and charge detector and a transmitter cover pressure sensitive switch to detect tampering with the body worn transmitter.

16. The tamper detection system according to claim 15 wherein the body worn transmitter additionally contains an electrolytic immersion sensor sending a tamper inhibit signal to a tamper detection circuit in the body worn transmitter.

17. The tamper detection system according to claim 16 wherein the antenna has a conductive corrosion resistant metal foil core

and a resistive coating to prevent direct electrical contact with the subject's appendage.

TAMPER DETECTION FOR BODY WORN TRANSMITTER

ABSTRACT

A body worn transmitter and its associated portable monitoring receiver receiving global position signals, is provided with tamper detection to support twenty-four hour violation reporting from a subject under community supervision moves about the community. The body worn transmitter incorporates active radio frequency sensors to determine if the body worn transmitter has either been removed from the subject's body or the attachment strap has experienced tampering for the purpose of removal from the subject's body. A signal from the body worn transmitter is encrypted in order to prevent recording and retransmission of the body worn transmitter signal to an associated portable monitoring receiver for the purposes of masking body worn transmitter tampering or to make the body worn transmitter falsely appear in a different location. The body worn transmitter can be immersed in electrolyte solutions without generating a false tamper signal.

**DECLARATION, ENGLISH LANGUAGE DECLARATION,
POWER OF ATTORNEY FOR PATENT APPLICATION**

As the below named inventor(s), We/I hereby declare that:

My (our) residence, post office address, and citizenship are stated below next to my(our) name and signature,

I/We believe we/I am/are the original, first, and sole(joint) inventor(s) of the subject matter which is claimed and for which a patent is sought on the invention entitled,

TAMPER DETECTION FOR BODY WORN TRANSMITTER described in:

(X) the specification filed herewith.

() application serial no. _____, filed _____

and was amended on _____
If Applicable

I/We hereby state that I/we can read and understand the English language and have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I/We acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I/We hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
<u>NONE</u>			Yes	No
Country	Application No.	Filing Date		
Country	Application No.	Filing Date	Yes	No

I/We hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I/we acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application in accordance with Title 37, Code of Federal Regulations, §1.63(d).

Application No.	Filing Date	Status
NONE		

I/We hereby declare that all statements made herein of my(our) own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Title 18, United States Code, §1001, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As the named inventor(s), I/we hereby appoint Herbert W. Larson (Reg No. 21,008) and James E. Larson (Reg. No. 37,867) to prosecute this application and transact all business in the United States Patent and Trademark Office connected herewith.

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Inventor's Signature: [Signature] Date: 5/27/97

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Post Office Address: Same Citizenship: U.S. Citizen

Full name of second joint inventor: DAVID S. SEGAL

Second Inventor's Signature: [Signature] Date: 5/27/97

Residence: 680 STILL MEADOWS CIRCLE, PALM HARBOR, FL 34683

Post Office Address: Same Citizenship: U.S. Citizen

Full name of third inventor: PETER LEFFERSON

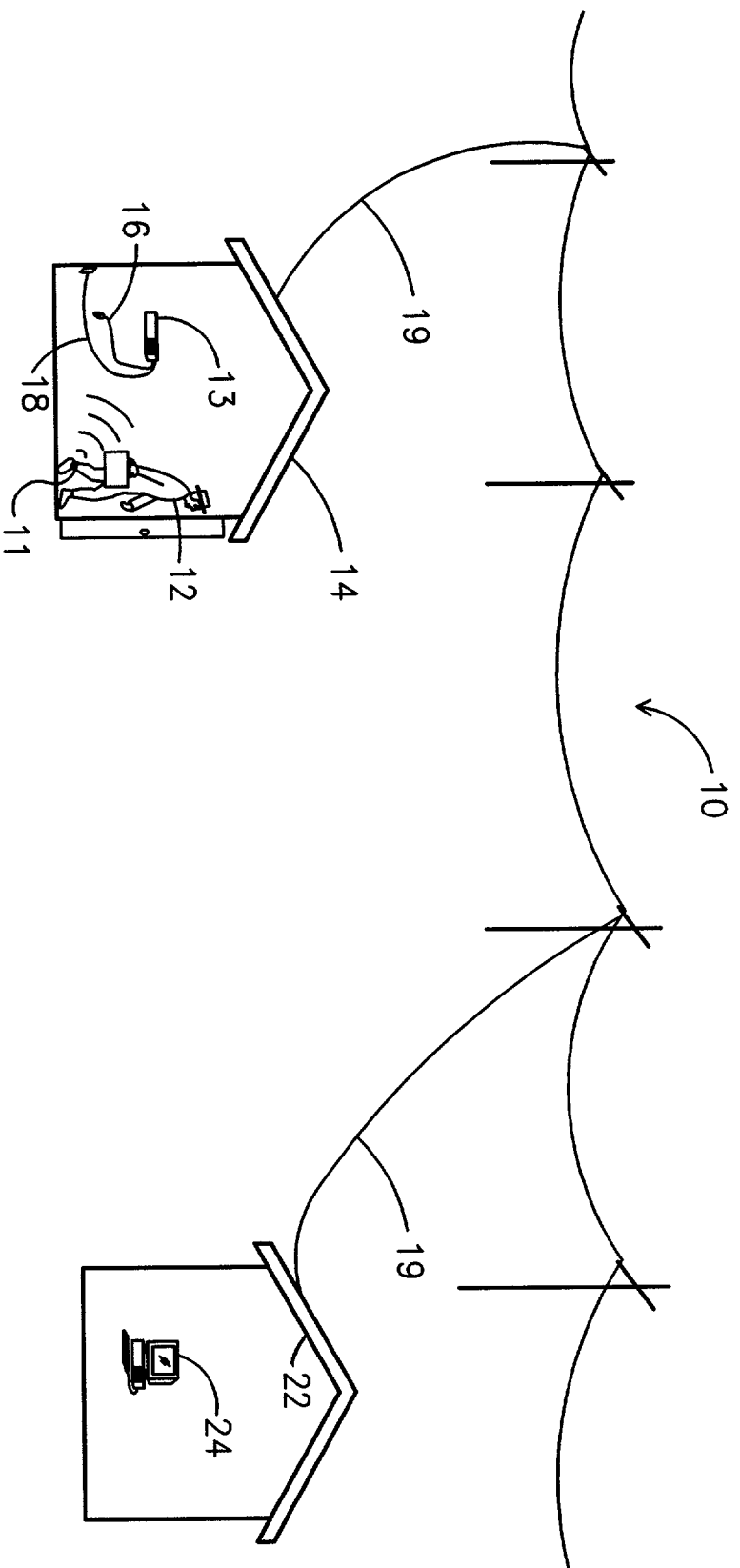
Second Inventor's Signature:  Date: 5/27/97

Residence: 6101 7TH AVENUE N., ST. PETERSBURG, FL 33710-7015

Post Office Address: Same

Citizenship: U.S. Citizen

462230 2569880



PRIOR ART

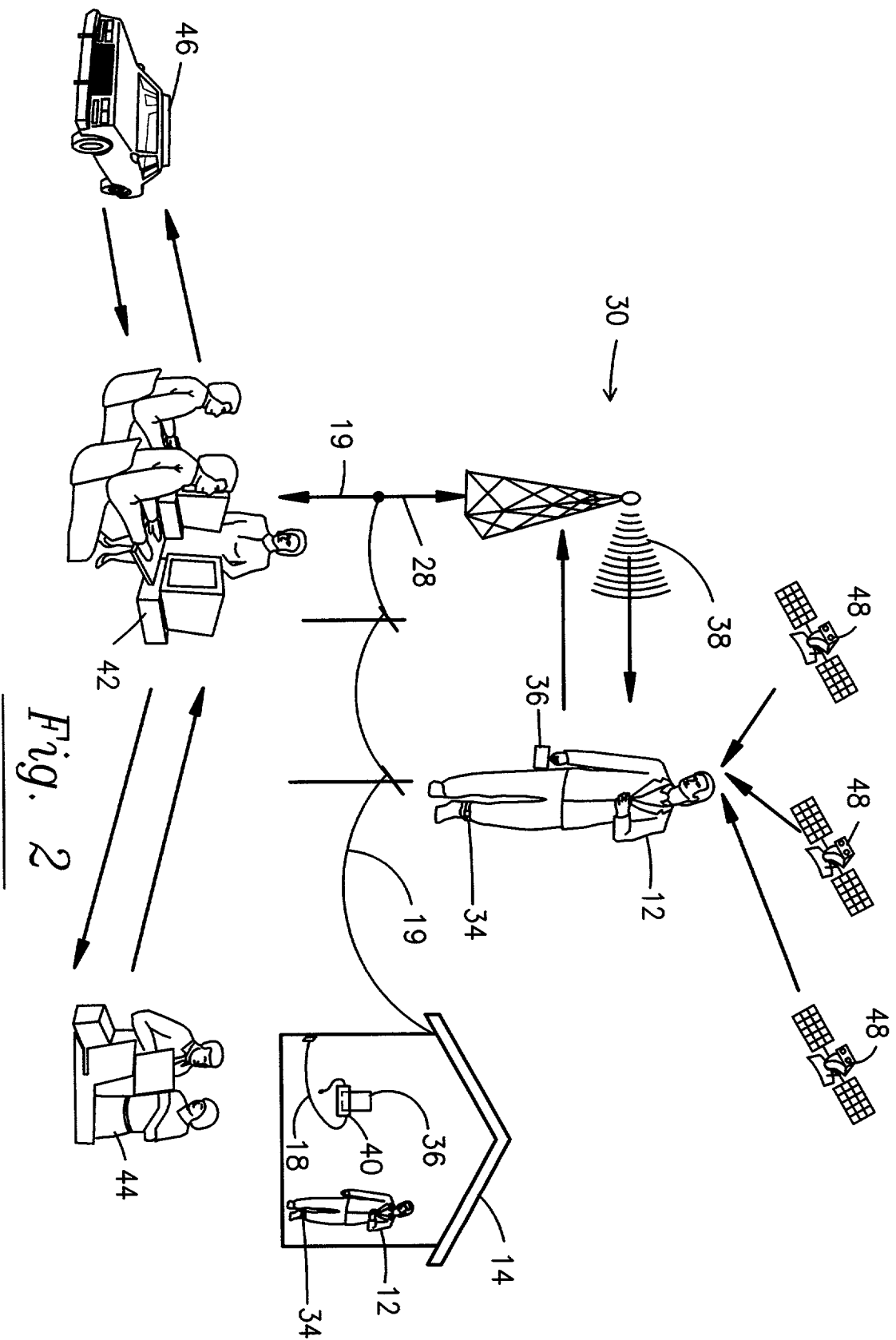
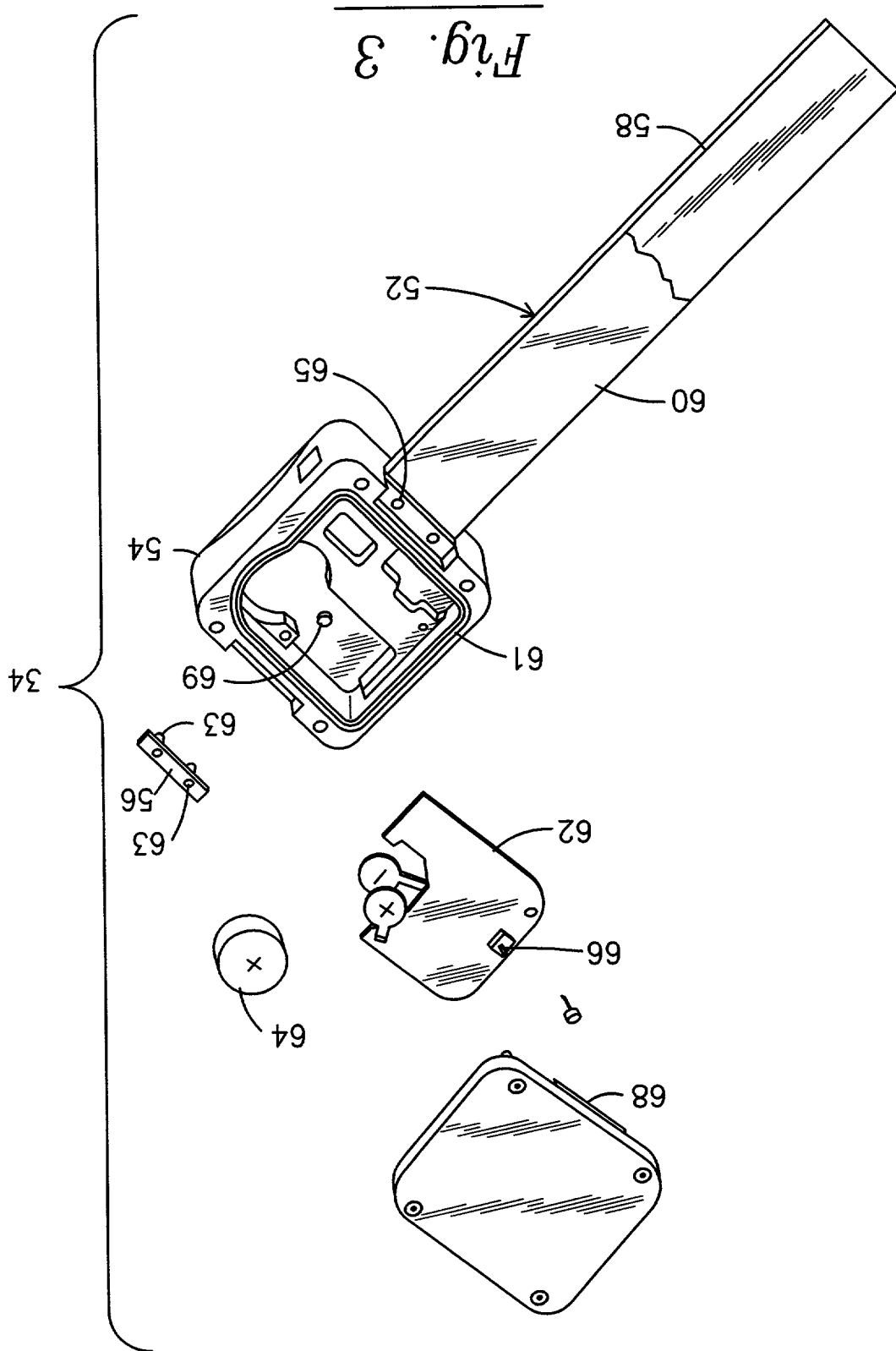


Fig. 2



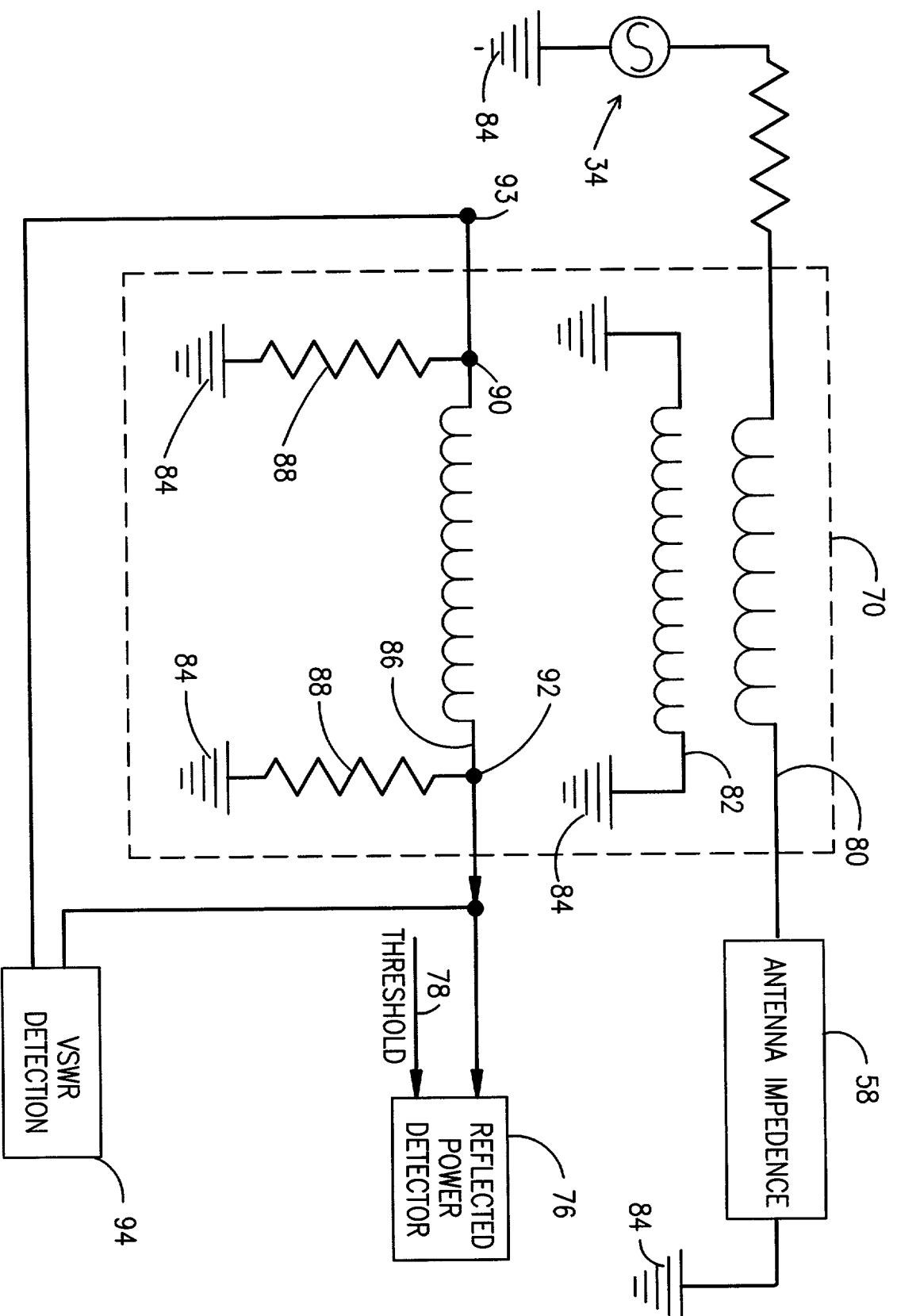


Fig. 4

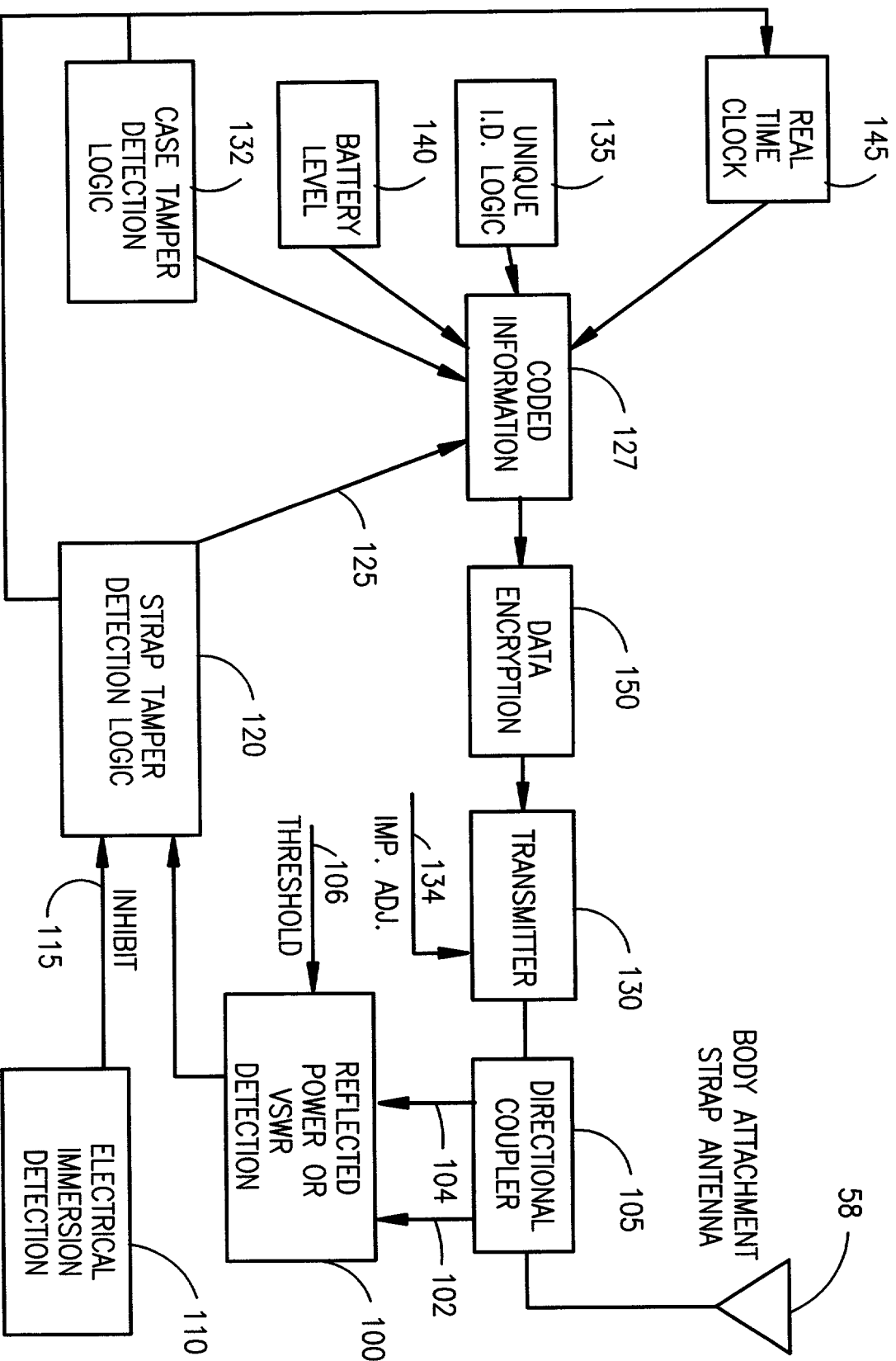
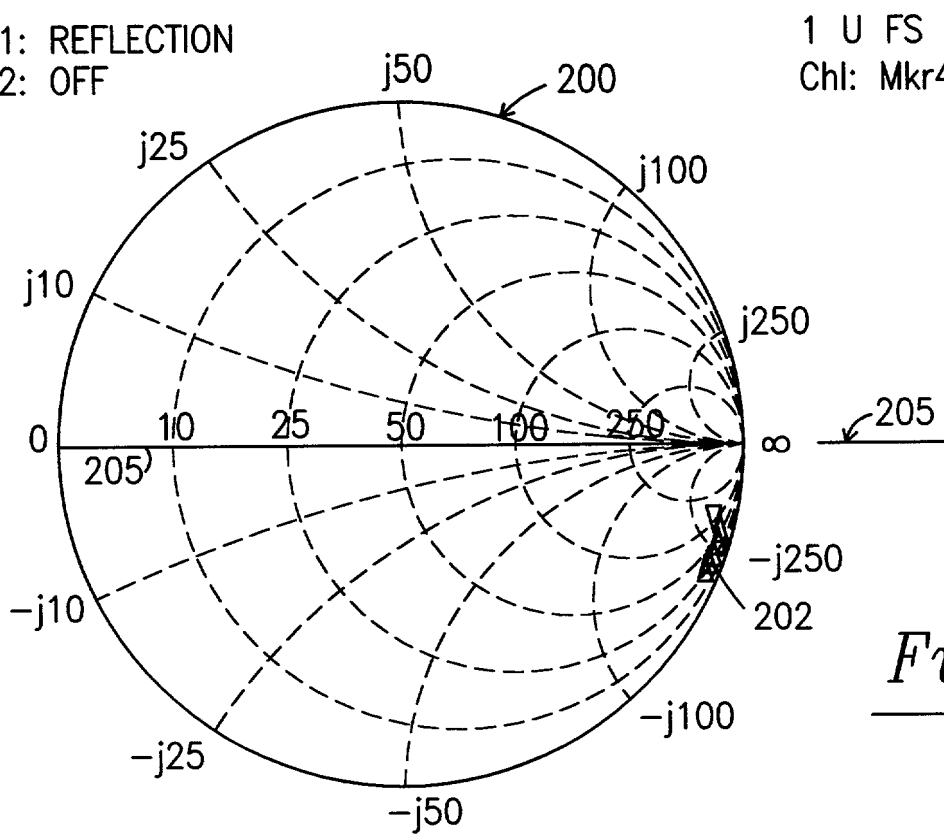


Fig. 5

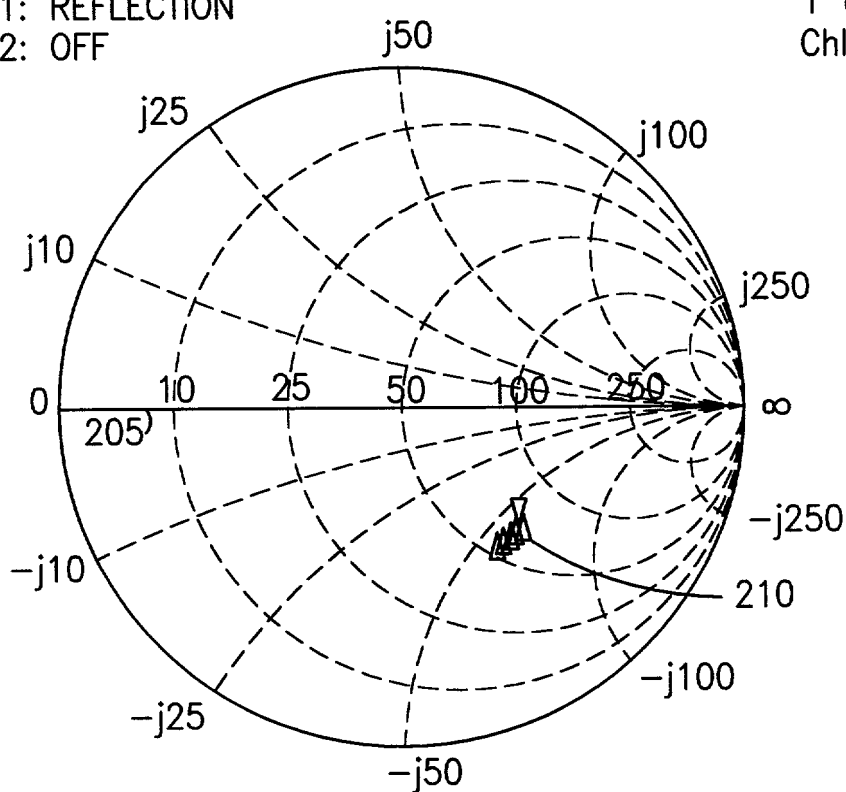
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1 U FS
Chl: Mkr4 418.00Mhz
49.96 Ω
-280.8 Ω
1.356 pF

Fig. 6A

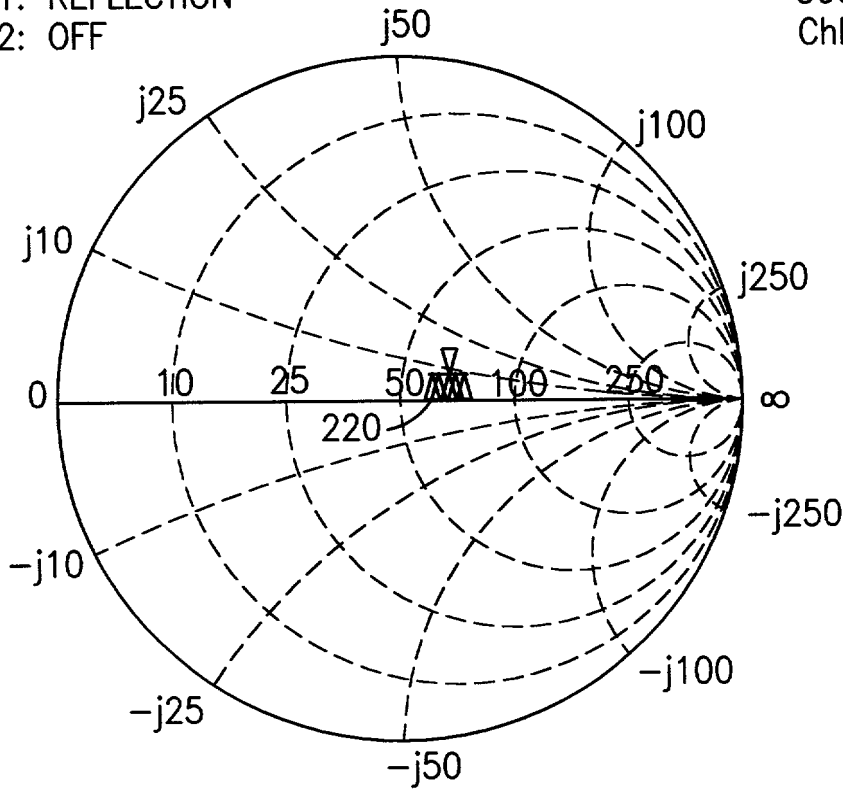
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1 U FS
Chl: Mkr4 418.00Mhz
63.13 Ω
-57.97 Ω
6.569 pF

Fig. 6B

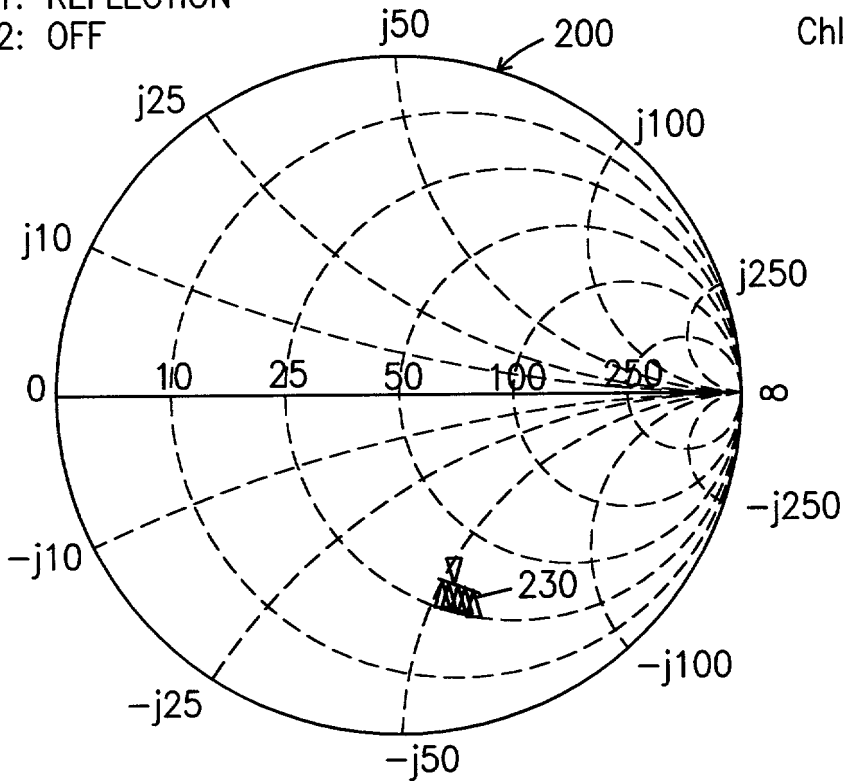
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500 mU FS
Chl: Mkr4 418.00Mhz
54.68 Ω
4.353 Ω
1.657 pH

Fig. 6C

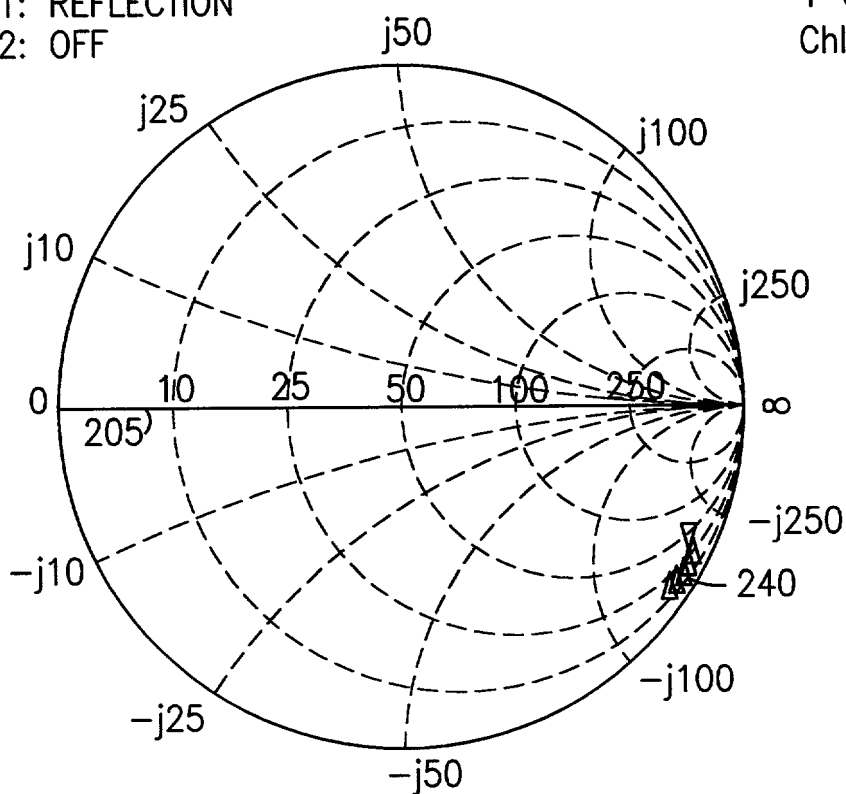
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Chl: Mkr4 418.00Mhz
31.76 Ω
-52.81 Ω
7.21 pF

Fig. 6D

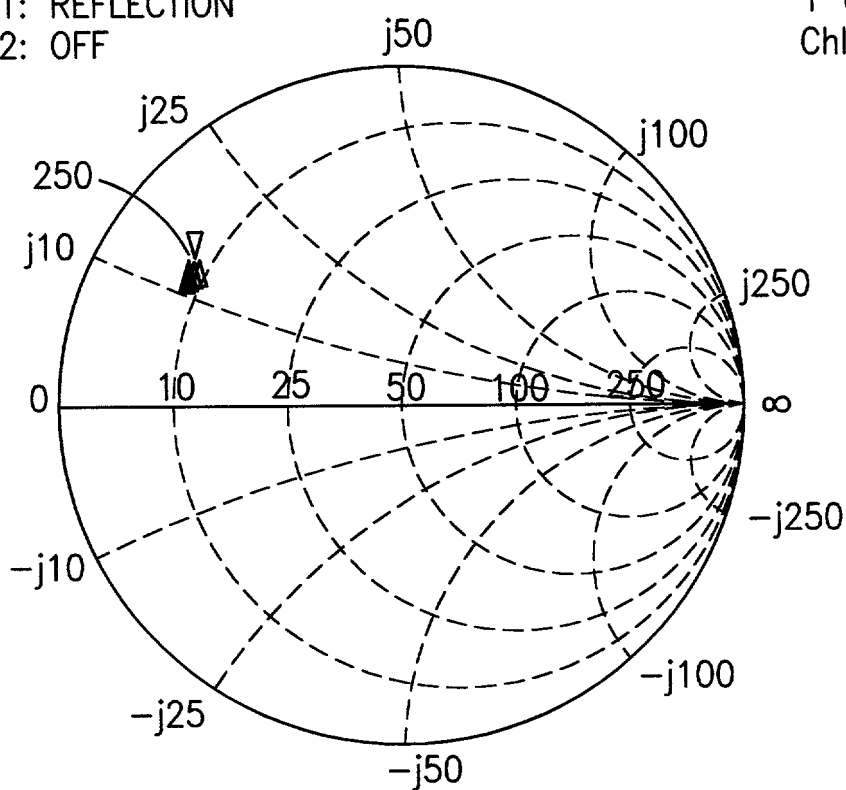
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1 U FS
Chl: Mkr4 418.00Mhz
32.65 Ω
-186.4 Ω
2.043 pF

Fig. 6E

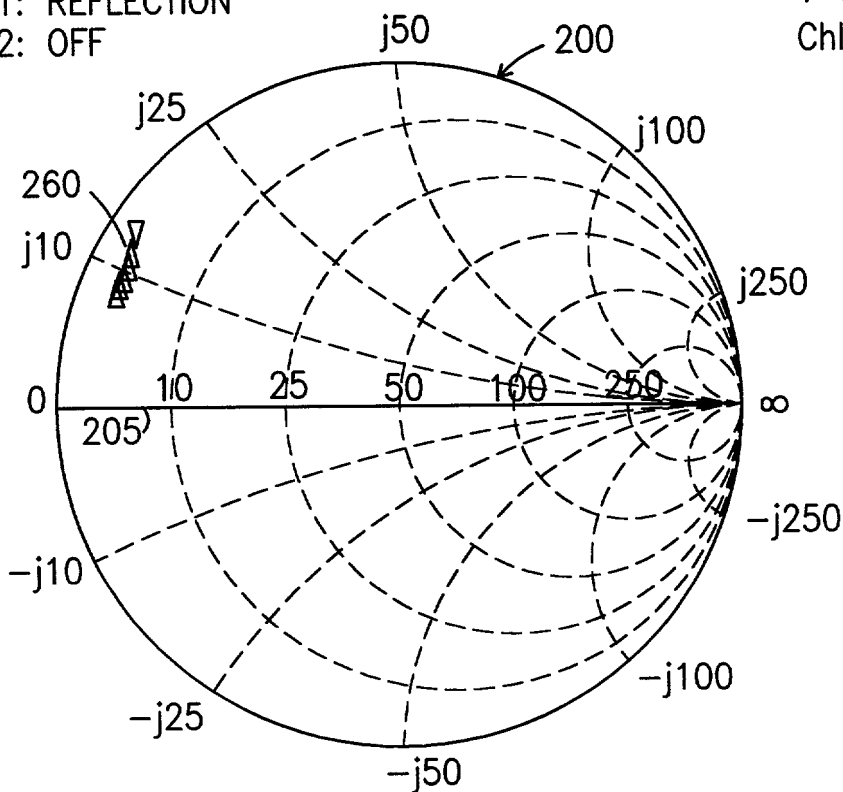
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1 U FS
Chl: Mkr8 434.00 Mhz
8.384 Ω
13.19 Ω
4.839 pF

Fig. 6F

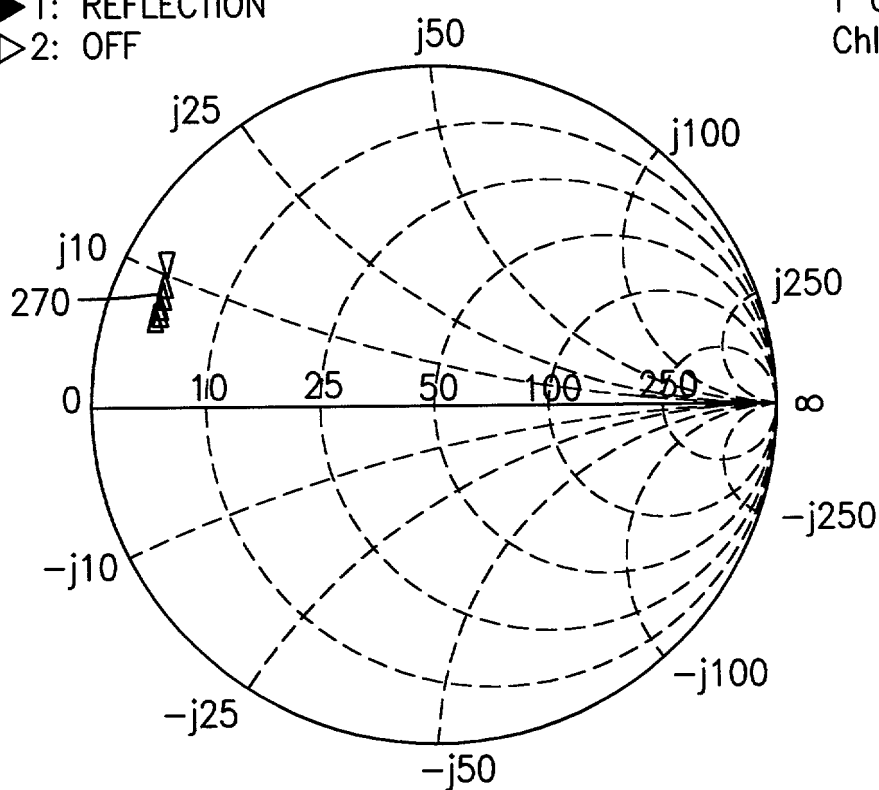
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1 U FS
Chl: Mkr8 434.00 Mhz
3.246 Ω
12.25 Ω
4.491 pF

Fig. 6G

► 1: REFLECTION
▷ 2: OFF



1 U FS
Chl: Mkr4 418.00 Mhz
9.416 Ω
4.489 Ω
3.585 pF

Fig. 6H

Applicant or Patentee: HOYT M. LAYSON, JR.; DAVID S. SEGAL and
PETER LEFFERSON

Serial or Patent No.:

Docket No.: 818.3

Filed or Issued:

For: TAMPER DETECTION FOR BODY WORN TRANSMITTER

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL
ENTITY STATUS (37 CFR 1.9(F) AND 1.27(B) INDEPENDENT INVENTOR**

As below-named inventor(s), I/We hereby declare that I/We qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled TAMPER DETECTION FOR BODY WORN TRANSMITTER described in:

[X] The specification filed herewith
[] Application Serial No. _____, filed _____
[] Patent No. _____, issued _____

I/We have not assigned, granted, conveyed or licensed and am (are) under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9(d) or a non-profit organization under 37 CFR 1.9 (e).

Each person, concern or organization to which I/We have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

[] No such person, concern or organization
[X] Person, concerns or organizations listed below*

*NOTE separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27).

FULL NAME PRO TECH MONITORING, INC.
ADDRESS 2708 U.S. ALT 19 NORTH, STE. 503, PALM HARBOR, FL 34683

[] INDIVIDUAL
[x] SMALL BUSINESS CONCERN
[] NON-PROFIT ORGANIZATION

FULL NAME _____
ADDRESS _____
[] INDIVIDUAL
[] SMALL BUSINESS CONCERN
[] NON-PROFIT ORGANIZATION

262250 851E9880

I/We acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b)).

I/We hereby declare that all statements made herein of my own (our) knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

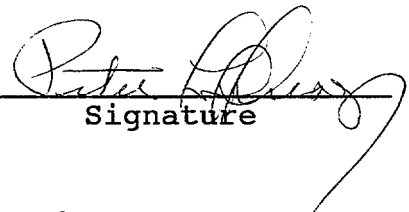
HOYT M. LAYSON, JR.
Name of Inventor

DAVID S. SEGAL
Name of Inventor

PETER LEFFERSON
Name of Inventor


Signature


Signature


Signature

MAY 27, 1997
Date

May 27, 1997
Date

May 27, 1997
Date

46250-25E9880

Applicant or Patentee: HOYT M. LAYSON, JR.; DAVID S. SEGAL & PETER LEFFERSON

Serial or Patent No.: _____

Filed or issued: _____

For: TAMPER DETECTION FOR BODY WORN TRANSMITTER

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS (37 CFR 1.9(f) and 1.27 (c)) - SMALL BUSINESS CONCERN**

I hereby declare that I am

- () the owner of the small business concern identified below:
(X) an official of the small business concern empowered to act
on behalf of the concern identified below:

NAME OF CONCERN PRO TECH MONITORING, INC.

ADDRESS OF CONCERN 2708 U.S. ALT 19 NORTH, STE. 503,
PALM HARBOR, FL 34683

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9 (d), for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time, or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third-party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed, to and remain with the small business concern identified above with regard to the invention, entitled

TAMPER DETECTION FOR BODY WORN TRANSMITTER

by inventor(s) HOYT M. LAYSON, JR.; DAVID S. SEGAL and

PETER LEFFERSON

described in

(X) the specification filed herewith

() application serial no. _____ filed _____

2025-05-09 15:00:00

() patent no. _____, issued _____

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who could not qualify as a small business concern under 37 CFR 1.9(d) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).